A New Course on Sustainable Innovation and Entrepreneurship

Pritpal Singh, PhD

Department of Electrical and Computer Engineering, Villanova University, USA

Pritpal.singh@villanova.edu

Abstract

The UN Sustainable Development Goals (UN SDGs) provide a number of challenges in addressing poverty worldwide. To create momentum towards achieving these goals and the sub-goals (or targets), in many cases developing entrepreneurial solutions may be the best approach. We have developed and offered a new course based on an experiential learning pedagogy to educate students on creating entrepreneurial solutions to the UN SDGs.

The course begins with an overview of the UN SDGs and an introduction to entrepreneurship. The course then focuses on ideation and opportunity identification for solutions addressing one of the SDGs. The students are then introduced to the business model canvas, including the Presidio graduate school extension that enhances the Business Model Canvas by adding questions specifically related to sustainability considerations of the business model development. The next step in the course development is teaching the students how to develop minimum viable products through a process of rapid prototyping. In parallel with the formal teaching and activities in the classroom, the students are required to develop a venture concept outside the classroom. This concept is posted to a discussion board where the students' peers and the professor are asked to provide feedback to the students posting their venture ideas. The next step in the course is to go through a customer discovery process in which students are asked to learn from potential customers what are the customers' pains, difficulties that they are looking for solutions. Again, the results of these interviews with potential customers are posted on the course discussion board for peer and professor review and feedback. The business model and concept is refined by the students and then the students move into a customer validation phase where the talk to a number of potential customers/early adopters to refine their prototype solution. Finally, the students are then taught how to develop a sales strategy and to actualize some sales of their products.

The course work is supported by local expertise including a sales consultant, a logo design/branding expert, a supply chain expert, and experts in corporate structures, venture financing and intellectual property. The students present their final product/service design, their venture strategy, and sustainability metrics that they will use to gauge the performance of their ventures specifically against the sustainability aspects of the solution.

This paper will present more details of the activities conducted in the class, a description of the student learning outcomes and how well they were achieved and plans on further developing the course based on student feedback.

1. Introduction

The United Nations laid out an updated set of Sustainable Development Goals (UN SDGs) in 2015 that superseded the Millenium Development Goals that expired in the same year [1]. There are seventeen goals and 169 targets to be achieved by 2030 that address areas such as clean water and sanitation, affordable and renewable energy, quality education, good health and well-being, etc. Many of these goals are very

ambitious, such as “provide access to clean and affordable energy to everyone in the world.” As we enter the fifth year of the 15-year time frame to achieve the goals, we are still lagging behind on many of them [2]. Most development programs are funded through international aid programs, international non-governmental organizations (NGOs) or through government programs. Yet, these are primarily grant funded projects and have little consideration for bringing solutions to scale [3]. An approach that has a greater likelihood of success in achieving these goals is to consider entrepreneurial solutions. There are many examples of how social enterprises have been able to contribute to sustainable development in a large scale. One such example is that of Green Light Planet [4] that has developed a line of portable solar electric systems to provide clean electricity access to rural communities.

Recognizing the important ways in which entrepreneurially minded thinking can lead to the development of scalable solutions to address the UN Sustainable Development goals, we embarked on the preparation of a postgraduate class on this topic to educate students who specialize in the International Development Track of the Masters in Sustainable Engineering at Villanova University. The subsequent sections of this paper describe the content of the course, the different innovations and business models that resulted from the first iteration of teaching the class, and lessons learned.

2. Course Structure

The course was titled “Sustainable Innovation and Entrepreneurship” and was a semester long (15-week course). There were three course objectives defined as, by the end of the course, the students should have:

1) Understood and applied the entrepreneurial mindset through experience to addressing a UN SDG challenge;
2) Analyzed and evaluated opportunities for identification of a viable business opportunity related to the UN SDGs;
3) Created an initial venture concept with product/market fit to address a UN SDG challenge.

Recognizing that the students in the class were mostly Master’s and PhD students in the Sustainable Engineering program, only about 20% of the course was focused on sustainable engineering concepts and the remaining 80% of the course was focused on the entrepreneurship concepts. With this focus in mind, the textbook selected for the course was “*The Start Up Owner’s Manual*” by S. Blank and B. Dorf [5], a “manual” to entrepreneurs who are interested in starting their own business. The week-by-week breakdown of topics covered in the course are given in Table 1.

The class started with a presentation of the historical evolution of the UN SDGs starting with the Millenium Development Goals. The students were introduced to the issues and challenges that the developing world faces and gave examples of solutions that failed because of not being developed through a holistic perspective (e.g. the Playpump). This topic was followed by an introduction to entrepreneurship. The coverage in this topic included understanding the different types of enterprises (e.g. small businesses, social enterprises, etc.), what is meant by value proposition, and common pitfalls made by inexperienced entrepreneurs.

The next topic covered in the course was to help students consider the opportunities for innovations in the sustainable development space. Several ideation techniques including brainstorming, painstorming, lateral thinking, biomimicry, etc. were described and the students were then given scenarios to which to apply the techniques in an activity during the class period. This approach was used to illustrate the utility of the different approaches.

Table 1. Week-by-week topical coverage

Week Number	Topic(s) Covered
1	Review of UN SDGs; Introduction to Entrepreneurship
2	Ideation and Opportunity Identification related to the UN SDGs
3	Introduction to customer discovery; value proposition
4	Rapid Prototyping; Minimum Viable Product design;
5	Introduction to the Business Model Canvas (including the Presidio Extension)
6	**Intellectual Property (Guest speaker)**
7	Customer Discovery I: Stating Business Model Hypotheses
8	Customer Discovery II: Understand the Customer
9	Customer Discovery III: Test the Solution
10	Sales/Marketing/Customer Validation I
11	Sales/Marketing/Customer Validation II
12	Customer Validation III/Sales Metrics
13	Impact Assessment, Sustainability Metrics
14	**Invited entrepreneur (Guest speaker)**
15	Student Presentations

An important concept for new entrepreneurs is that of a minimum viable product (MVP). The idea of rapid prototyping and creating a MVP was presented next. Having an initial prototype to share with potential customers is an important way for entrepreneurs to refine their product design in a short time with a relatively low investment of funds. The next topic covered was the business model canvas. Introduced by Osterwalder and Peigneur [6], this is a useful tool to experiment with different business model concepts. An enhancement to the Business Model Canvas that allows sustainability considerations to be added to the tool was developed by the Presidio Graduate School in Michigan [7]. This enhancement was also presented during the discussion of the Business Model Canvas tool. Homework and in-class exercises were developed for the students to gain practice with the use of these tools.

The next three classes covered the topics of customer discovery. They were designed to show students how to engage with potential customers. The first step in this customer discovery phase was to apply active listening skills to better define what the potential customer likes/dislikes about the business model, prototype, etc. The second step is then to refine the business model/concept to better align with meeting the needs of the customer. The third step is then to reevaluate the modified solution by again engaging with the potential customer. In these segments, several videos of how to engage customers were presented, particularly ones developed and presented by Steve Blank. As an in-class exercise, the students were asked to role play potential customers and entrepreneurs and practice the skills being taught in the class.

The next two classes were focused on how to sell to potential customers. A guest speaker who runs her own sales and marketing consulting company was brought in as a guest speaker for this class along with a branding expert who talked about logo design. As homework exercises, the students were asked to develop

a logo and a sales pitch for their proposed business ventures and present it to the class. The other students in the class were then asked to provide peer feedback.

As the students were progressing along in the class, they were asked to start thinking about developing a business venture that targeted a specific UN SDG. They were asked to post their business concepts on the course management system (Blackboard) website and provide peer feedback to their peers. Part of their final grade was based on how engaged they were in class discussions as well as in providing peer feedback in the Blackboard site.

Following the instruction on how to engage with potential customers, and having received feedback from the instructor and the students' class peers, they were asked to find at least 10 potential customers, five who they knew and five who they did not know, to get feedback on their business ideas. They were then able to use this feedback to refine their business concepts.

The final topic of the class was a discussion of social return on investment (SROI) assessment. The SROI approach was chosen since it is a well-developed methodology and is a very appropriate approach for the social enterprises that the students were developing.

In addition to the topics mentioned above, we had a guest speaker talk about sustainable supply chains and a young entrepreneur talk about his journey to date on the entrepreneurial path. This latter talk was particularly effective for the students because it underscored many of the topics covered throughout the semester.

The final deliverable for the class was a proposal that the students had to prepare in the format of the IEEE SIGHT project proposals. IEEE is the professional society of electrical, electronic and computer engineers and is the largest engineering professional organization with a global membership of >400,000 engineers. The Special Interest Group in Humanitarian Technology (SIGHT) program supports IEEE volunteers who wish to engage use their technical skills to address any of the UN sustainable development goals in their local communities [8]. In addition to addressing the SIGHT proposals, the students were also asked to prepare and include in their final reports a completed business model canvas, including the questions from the Presidio extension. In addition to a final report, the students had to present their ventures in front of the class and get feedback from the instructors, guest visitors and their class peers.

3. Pedagogical Approach and Resources Employed

The course was taught using a number of tools. Videos, particularly inspirational or example videos of startup companies working in the sustainable development space, were employed in the class presentations. The present course development was funded by a grant from Venture Well [9], an organization that promotes technology-based innovation and entrepreneurship on college and university campuses in the US. They have several videos that are accessible through their website that highlight startup companies that have been supported through their grants. An example of such a video highlights Ecovative Design, a company that has developed a mushroom-based material for sustainable packaging [10].

Another set of useful videos that were employed in the teaching of the class were ones from Steve Blank's website [11]. These short videos are very focused and provide a good lesson in each video.

A number of exercises were also assigned to the students as activities to be performed during the class period related to the various entrepreneurship topics. All the in-class exercises were focused on sustainable development challenges. An example of such an in-class activity was having the students go through a rapid prototyping exercise on bringing clean water to members of a developing world community.

Finally, as mentioned earlier, having guest speakers come in and give presentations on topics such as sustainable supply chain, starting your own company, intellectual property, sales, logo development, etc. provided more subject matter expertise for specific topics.

4. Student Ventures coming out of the class

The students developed several business ideas, and some are moving forward on further developing their startup ventures. Three ventures are provided here as examples.

4.1 Sustainability Software Tool

The first venture that was actually started prior to the course was based on a Master's thesis. It is a software tool that allows organizations, such as companies, universities, etc. to do a comprehensive assessment of their performance over the 17 UN SDGs. Based on the data that is input into the software tool, recommendations are made for actions that may be taken by the organization to improve their scores in achieving the different UN SDG goals.

4.2 Trashpacks

This company was started by a student who lives near the beach and has been frustrated with seeing so much trash lying around as she jogs in the area. Her concept was to develop a portable trash can that can be carried as a backpack while running. As one sees trash, they can put it into the can that in her "trashpack". A picture of her conceptual prototype is shown in Figure 1.

Figure 1. Trashpacks prototype

4.3 Solar Confidence for Solar Disinfection (SOCO for SODIS)

The third example venture coming out of this class was developed by a team of four students, two Sustainable Engineering Master's students, and two electrical engineering postgraduate students. The issue that they were addressing was how to know whether dirty water placed in a plastic bottle and being disinfected by UV radiation from sunlight is clean enough to drink. They developed an electronic device for accumulating the UV radiation over time and when a threshold has been surpassed, a green indicator light would come on to indicate that the water is safe to drink. This project won an award last year in a global innovation competition and a proposal to develop and commercialize the technology has been submitted to Venture Well for an e-teams grant.

5. Student Feedback and Lessons Learned

This course received some very positive comments from the students. Given that it was the first time that the course was offered, it went quite smoothly. A couple of the students' comments were:

"The course structure and the assigned projects require the student to apply what is learned towards actual venture development. I found this to be very effective in understanding the material as I was learning by doing."

"I really enjoyed the class and learned a lot"

"I felt that the course started off strong and then somewhat fell flat halfway through. I felt that there was an inordinate amount of time spent on "selling" and talking to potential customers."

Overall, the course went well. However, I agree that some additional topics (e.g. startup accelerator programs) and additional guest speakers could have enhanced the class. On the other hand, while some students complained about having to engage with potential customers, understanding the customer, learning to actively listen to a potential customer and then getting feedback from potential customers is an extremely important skill that startup entrepreneurs need to develop.

6. Conclusions

This paper has presented details on a new course on Sustainable Innovation and Entrepreneurship that was taught this past fall term. The main audience for this class was Sustainable Engineering graduate students. The class focused on educating students on how to develop entrepreneurial ventures to address sustainable development challenges. The course included a number of topics on entrepreneurship and used an active learning approach where students applied their knowledge gained in the class lectures into the ventures that they were developing. Several startup companies have come out of the course and are now being advanced by the students. Further mentoring support will be provided over the coming few months as the students move their ventures forward.

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8. References

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